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GENUS *DIAPLOCOCERAS* (AMMONOIDEA) FROM THE LOWER TRIASSIC OF MUĆ, CROATIA

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In the ammonite fauna of the Upper Scythian (Lower Triassic) three species of the genus *Diaplococeras* have been defined so far: *D. liccanum* (HAUER), *D. circumplicatus* (MOJSISOVICS) and *D. connectens* (MOJSISOVICS). *D. liccanum* is (positively) a valid species, and *D. circumplicatus* and *D. connectens* are of questionable validity, having been described on the basis of few and also very damaged specimens. During his research of the wider area of Muć village in Central Dalmatia in Croatia, the present author found many more fossils than have been known to date. Five species of the genus *Diaplococeras* were found, of which three species are new: *D. jazinkae, D. tridentatus* and *D. malici*. Material clarifying the question of the validity of the species *D. circumplicatus* was also found. The material is deposited in the Natural History Museum in Split. The species are elaborated taxonomically and biostratigraphically.

Key words: Ammonites, genus *Diaplococeras*, Upper Scythian, taxonomy, biostratigraphy, Muć, Croatia

Golubić, V.: Rod *Diaplococeras* (amoniti) iz donjeg trijasa Muća u Hrvatskoj, Nat. Croat., Vol. 7, No. 2, 143–158, 1998, Zagreb

U fauni amonita gornjeg skita (donji trijas) dosad su bile poznate tri vrste roda *Diaplococeras*: *D. liccanum* (HAUER), *D. circumplicatus* (MOJSISOVICS) i *D. connectens* (MOJSISOVICS). *D. liccanum* je pouzdano validna vrsta, a *D. circumplicatus* i *D. connectens* su upitne vrste – opisane su na temelju malo i, uz to, vrlo oštećenih primjeraka. Autor je, istražujući širu okolicu sela Muć u srednjoj Dalmaciji u Hrvatskoj, našao bogatiji fosilni materijal od dosad poznatog. Nađeno je pet vrsta roda *Diaplococeras*, od čega tri nove: *D. jazinkae, D. tridentatus* i *D. malići*. Nađen je materijal koji razjašnjava pitanje validnosti vrste *D. circumplicatus*. Materijal je deponiran u Prirodoslovnom muzeju u Splitu. Vrste su obrađene taksonomski i biostratigrafski.

Ključne riječi: amoniti, rod *Diaplococeras*, donji trijas (gornji skit), taksonomija, biostratigrafija, Muć, Hrvatska

INTRODUCTION

MOJSISOVICS (1882: 8–10) described 3 species of the genus *Diaplococeras* which he typologically placed in the genus *Dinarites*: one already known species, *D. liccanum* (*Ceratites liccanus* HAUER, 1865), and two new ones, *D. circumplicatus* and *D. connectens*. HYATT (1900: 556) in KUMMEL (1969: 503) suggested a new genus, *Diaplococeras*, for the species *Dinarites liccanus*. KITTL did not correctly recognize several specimens of *D.* aff. *circumplicatus* in material from Muć, and described them as a new species of the genus *Dinarites*: *D. biangulatus* KITTL (1903: 16–17) i *D. (Hercegovites) diocletiani* KITTL (1903: 23–24). KUMMEL (1969: 504) considers *D. circumplicatus* and *D. connectens* to be the same species, which is now questionable because of the features displayed by the new material from Muć. The first species of the genus *Diaplococeras* found in Muć and determined with certainty is *D. liccanum*, registered in HERAK et al. (1983: 100) (at that time only one, but a well preserved, specimen was deposited in the Croatian Natural History Museum in Zagreb). Species of the genus *Diaplococeras* are rare. Most of the material is so diagenetically damaged that it cannot be determined. During several years of fieldwork in the wider area of Muć, I found that species of the genus *Diaplococeras* can be found only in two neighbouring horizons, that the biostratigraphical range of their occurrence is precisely defined by the biostratigraphical sequence of the ammonite *Meekoceras disciforme* KRAFFT, 1909 (*M. disciforme* was found for the first time in Muć during this particular research). This fact, constantly confirmed during field-work, as well as ambiental observations, enabled me precisely to determine areas in which the species of the genus *Diaplococeras* should be looked for.

THE MAIN METHODOLOGICAL PROBLEM

It is well known that the Upper Scythian ammonites from Dalmatian localities are diagenetically very damaged. I tried to solve this problem by collecting a lot of fossils over a long period of time, and thoroughly investigating Upper Scythian layers in the Muć area. I found some well preserved specimens of the rare species, and many more damaged ones. *Diaplococeras* species are rare, and after long field work I have only a few preserved specimens. This preserved material implies that species so far unknown do exist. It also shows the variability of the suture of *D. liccanum*, and that has been unknown fact until now. The small number of specimens excludes the possibility of applying the population concept of taxonomical research, so I applied a typological concept as a satisfactory, i.e. the only possible, solution in this and in similar cases.

TAXONOMY

Superfamily CERATICEAE MOJSISOVICS, 1879

Family TIROLITIDAE MOJSISOVICS, 1882

Genus *Diaplococeras* HYATT, 1900

Diaplococeras liccanum (HAUER)

Fig. 1. A

Ceratites liccanus HAUER, 1865; *Dinarites liccanus* MOJSISOVICS, 1882; *Diaplococeras liccanum* HYATT, 1900.

There are four specimens in the Natural History Museum in Split that can be determined as a typical form of *D. liccanum* – they completely correspond to the specimen of *Dinarites liccanus* (HAUER), described by MOJSISOVICS 1882: 8, Pl. IV, 1. There are 35 more specimens determined as *D.* cf. *liccanum* in the collection as well. Also, three rare variants of *D. liccanum* were found, out of which each has one specific characteristic of the suture.

Diaplococeras liccanum var. *bidentatus*

Plate III – 6; Fig. 1.C

The main, first, lobe is bifurcated like the »fish tail« and there are two teeth on the external lateral line.

I named the variant after this characteristic: the two teeth on the lateral line of the main (first) lateral lobe.

Diaplococeras liccanum var. *otarnicianus*

Plate I – 1; Fig. 2.A

The additional (second) lateral lobe has a sloping line with five little teeth.

It was found on Otarnik Hill, and I gave it a name after that locality.

Diaplococeras liccanum var. *monodentatus*

Fig. 2.B

The additional (second) lateral lobe is divided into two lobes, the external one having a shape of a long tooth.

The variant was named after the long tooth of the additional (second) lateral lobe.

The coil of the variants mentioned is the same as in *D. liccanum*.

Collection: *Diaplococeras liccanum* var. *bidentatus* –1 specimen (Inv.No.939), *Diaplococeras liccanum* var. *otarnicianus* – 2 specimens (Inv.No.952), *Diaplococeras liccanum* var. *monodentatus* – 1 specimen (Inv.No.802).

Diplococeras jazinkae n. sp.

Plate I – 2,3; Fig. 2.C,D

Holotype: Natural History Museum, Split. Inv. No. 949.

Derivatio nominis: after the mountain ridge Jazinka in Sutina village, built of Triassic deposits.

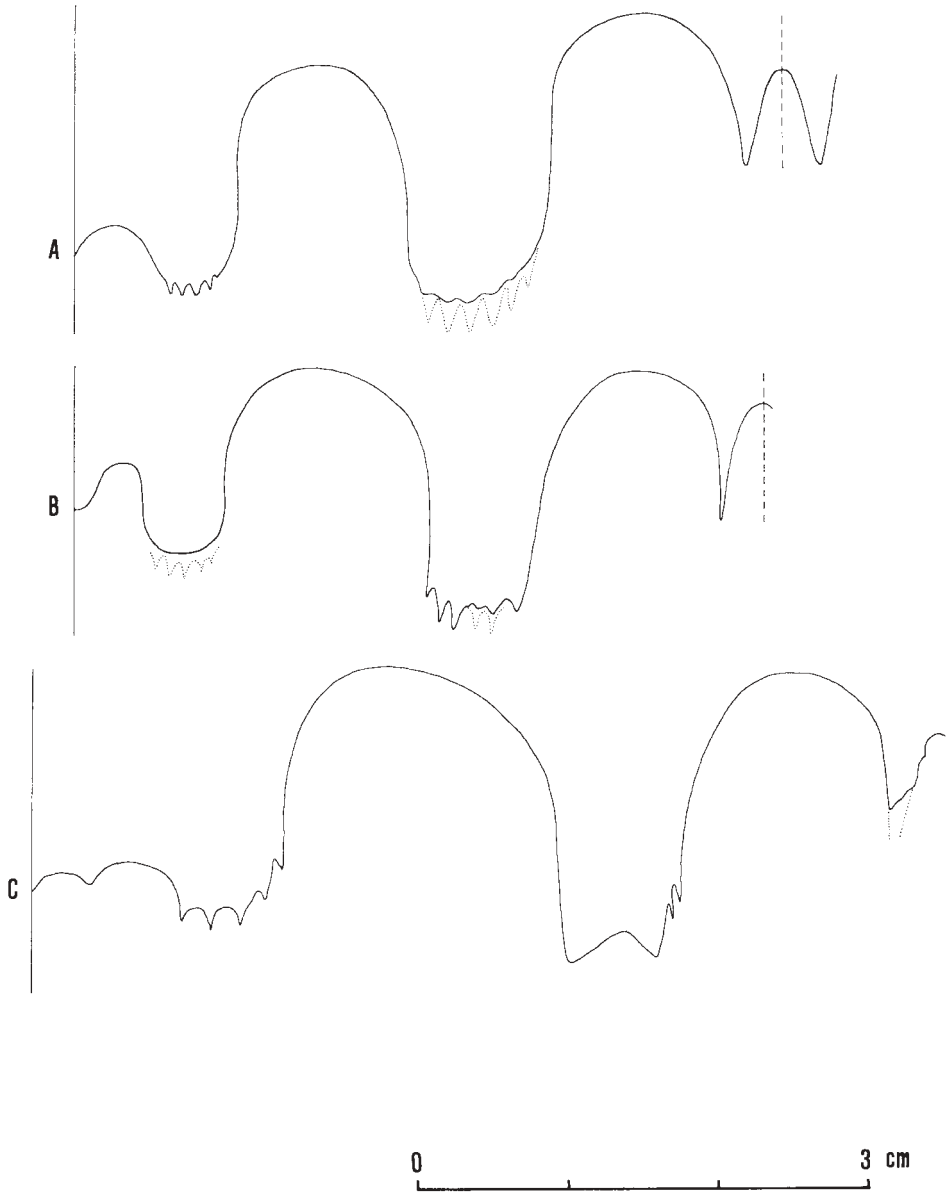

Fig. 1. Sutures: A, B – *Diaplococeras liccanum* (typical form), C – *D. liccanum* var. *bidentatus*

Locus typicus: Sutina village near Mućo.

Stratum typicum: Upper Scythian marl.

Diagnosis: Larger ammonite with flat, slightly evolute shell, coil with internal and external knots. Umbilical wall high and steep. Seam ceratitic with two lateral lobes. The main (first) lateral lobe is narrow and long, with five little teeth.

Description: It can be categorised as among the large Upper Scythian ammonites. Relatively flat, slightly evolute shell. Coil with very weak radial ribs with internal and external marginal knots. Umbilical wall high and steep. Ventral side of the spire slightly rounded. Suture: There is no lobe at the seam. A complete saddle is developed from the seam to the additional lateral lobe. The (second) additional lateral lobe is rounded, much shorter than the main (first) lateral lobe. The main (first) lateral lobe is narrow and long with five little teeth. Ventral lobes are long, pointed.

Holotype measurements: (holotype consists of approximately two thirds of the last coil) external diameter 112 mm, internal diameter 36 mm, maximum width of last coil ca 22 mm.

Differential trait, in relation to *D. liccanum*: the whole lateral part of the suture – considering the shape of the lobe and the teeth.

There are four specimens in the Natural History Museum in Split (Inv. No. 950, 949, 951, 1071).

Diaplococeras circumplicatus (MOJSISOVICS)

Plate II – 1–5; Fig. 3.A

Dinarites circumplicatus MOJSISOVICS, 1882; *Dinarites (Liccaitea) circumplicatus* KITTL, 1903; *Dinarites biangulatus* KITTL, 1903; *Dinarites (Hercegovites) diocletiani* KITTL, 1903.

MOJSISOVICS (1882: 8, plate III – 8, 9) could not describe the species precisely because he had specimens that were too damaged at his disposal. The important part is missing – the suture diagram. The new material from Mućo corresponds to the first description of the species, and to descriptions of Kittl's two species. The main inadequacy of the first description has now been overcome by giving the suture diagram. In the Natural History Museum in Split there are 29 damaged specimens, two of them with well preserved suture. KUMMEL (1969: 504) considers *D. circumplicatus* and *Dinarites connectens* MOJSISOVICS (1882: 9) to be the same species. *D. connectens*, though, has two lateral lobes and it has (probably) lost the ceratitic trait of the lobe. It is difficult to make a final decision on the basis of only one specimen. The present author is of the opinion that *D. circumplicatus* and *D. connectens* are two different species.

Diaplococeras tridentatus n. sp.

Plate II – 6., Fig. 3.B

Holotype: Natural History Museum, Split. Inv. No. 953.

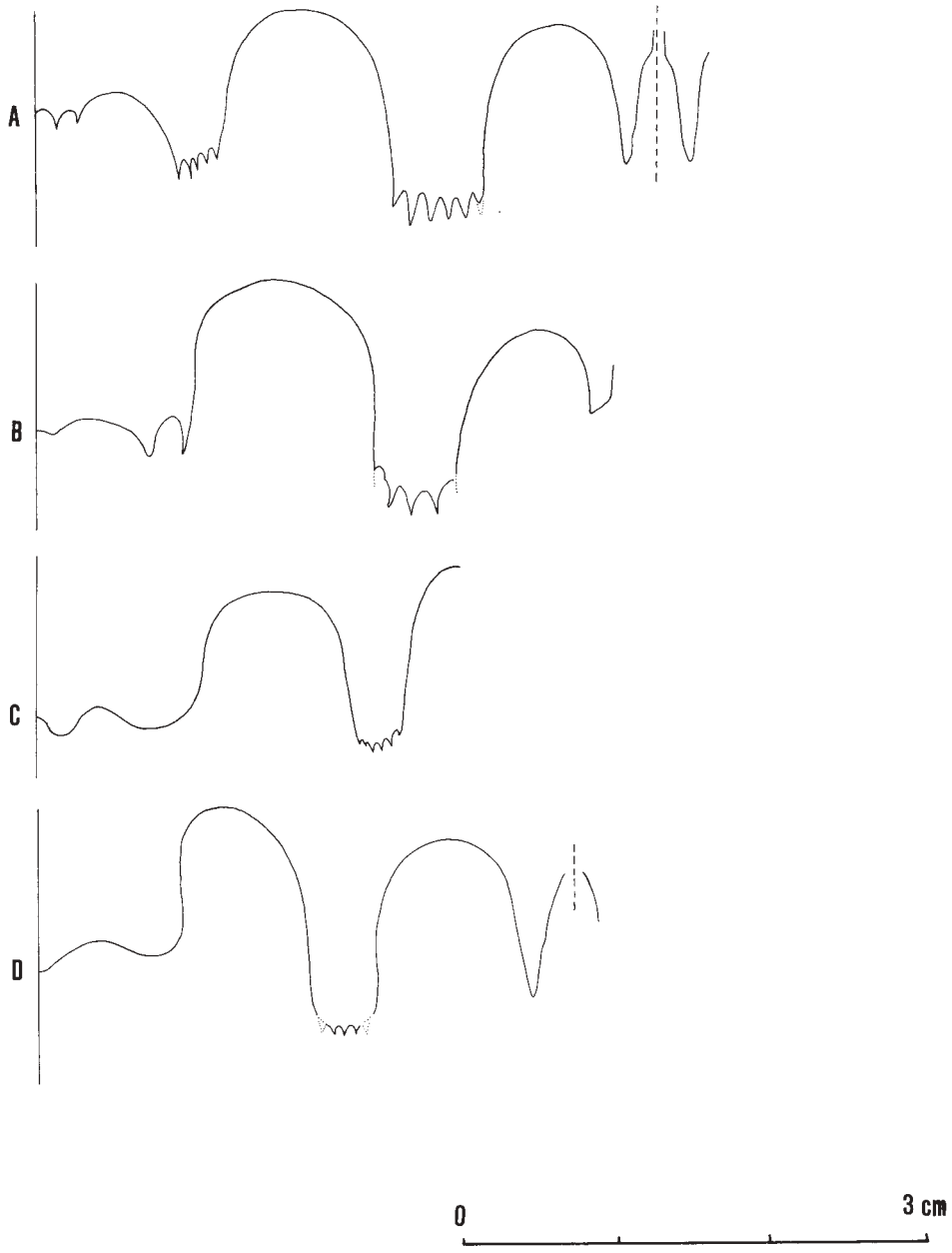

Fig. 2. Sutures: A – *Diaplococeras liccanum* var. *otarnicianus*, B – *D. liccanum* var. *monodentatus*, C, D – *D. jazinkae*

Derivatio nominis: *tridentatus* – three teeth at the seam and three teeth on the lateral lobe.

Locus typicus: Sutina village near Muć.

Stratum typicum: Upper Scythian marl

Diagnosis: Larger ammonite with flat, slightly evolute shell, coil with weak internal and external marginal knots. Umbilical wall steep. Seam ceratitic, with one lateral lobe with three teeth.

Description: Larger ammonite. Shell flat, slightly evolute. Spire with very weak radial ribs with internal and external marginal knots. Umbilical wall steep. Ventral side of the coil slightly rounded. Suture: At the seam there are three teeth. One lateral lobe with three teeth. Ventral lobes long, pointed.

Holotype measurements (holotype is damaged, so the measurements are approximate): external diameter 80 mm, internal diameter 24 mm, maximum width of the coil 15 mm.

Differential trait in relation to the other species of the genus concerns the suture diagram.

In the Natural History Museum in Split there are two specimens: holotype with a well preserved seam but very damaged living chamber, and one larger, very flat specimen.

Diaplococeras malici n.sp.

Plate III – 2–4; Fig. 3.C

Holotype: Natural History Museum, Split. Inv. No. 948.

Derivatio nominis: *malici* – after friar Josip Marko Malić (1857 – 1949), professor at the Franciscan Classical Gymnasium in Sinj, responsible for the collection of Upper Scythian ammonites, deposited in the Naturhistorisches Museum, Vienna.

Locus typicus: Sutina village near Muć

Stratum typicum: Upper Scythian marl

Diagnosis: Shell evolute, spire wide with weak ribs with very strong internal and external marginal knots. Seam ceratitic with two lateral lobes.

Description: Shell evolute, coils wide with weak ribs with very strong internal and external marginal knots. Some knots form spines. Umbilical wall high and steep. Ventral side of the coils is wide and flat. Coils a little bit wider next to the umbilical wall. Suture: The seam lobe moderately developed. Additional (second) lateral lobe is rounded and (probably due to damage) with five teeth. The main (first) lateral lobe with six teeth, two external lobes significantly smaller. Ventral lobes narrow, long, pointed.

Holotype measurements: (holotype is well preserved, but part of the living chamber is broken, so diameters are measured for the whole spire to the point of fracture) external diameter 62 mm, internal diameter 25 mm, maximum width of coil 21 mm.

In the collection of the Natural History Museum in Split, there are 11 specimens.

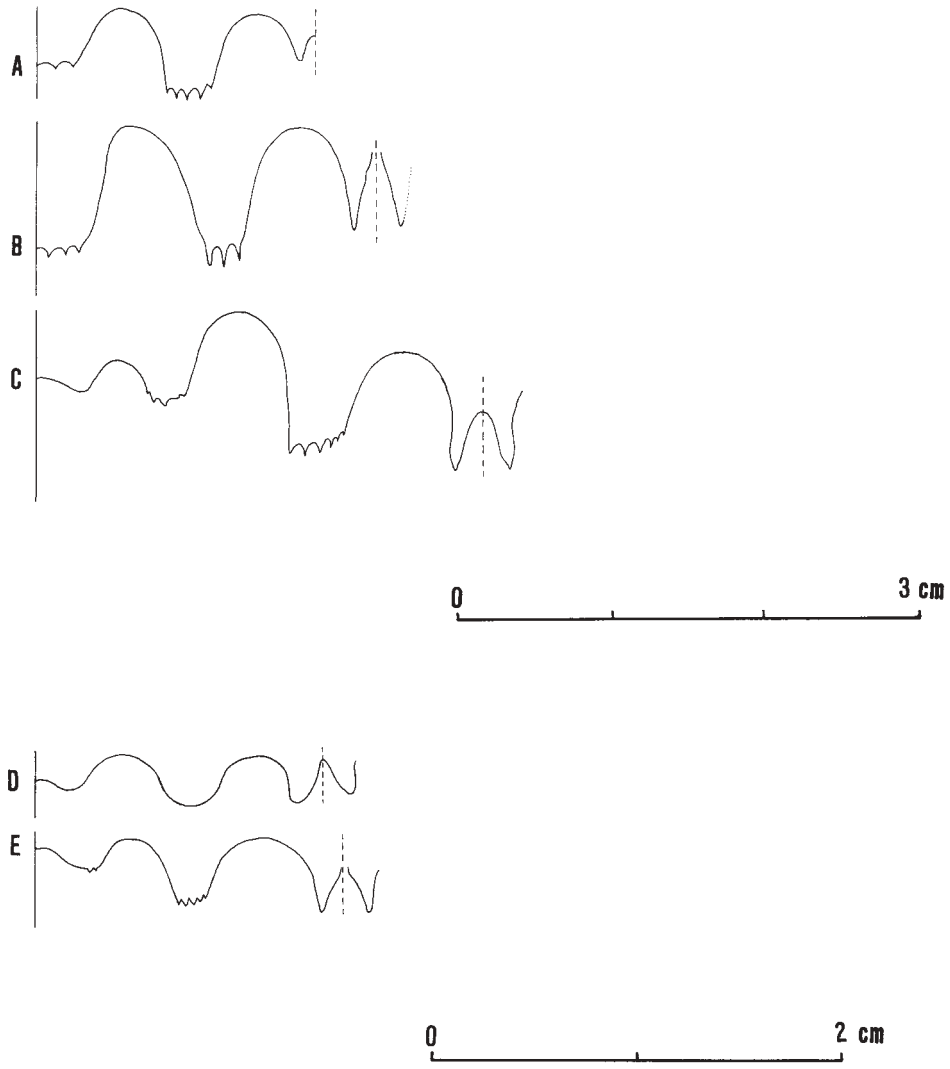

Fig. 3. Sutures: A – *Diaplococeras circumplicatus*, B – *D. tridentatus*, C – *D. malici*, D, E – *Meekoceras disciforme*

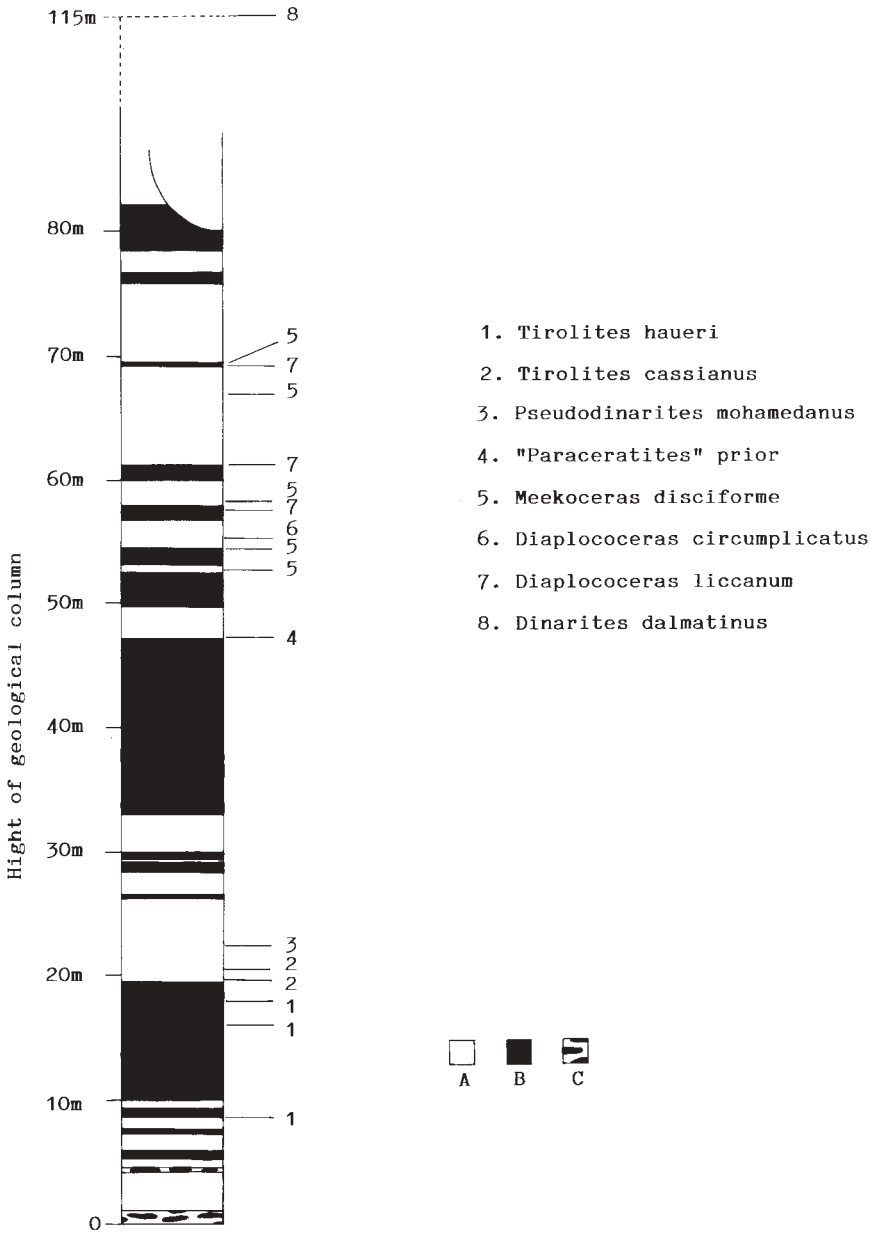

Fig. 4. The ammonites distribution in the lower part of the Upper Scythian layers on the standard section (Muć Gornji, Zmijovac); A: more that 70% marl, B: more than 70% limestone, C: marl with thin limestone layers and inclusions, with cca. 50% limestone

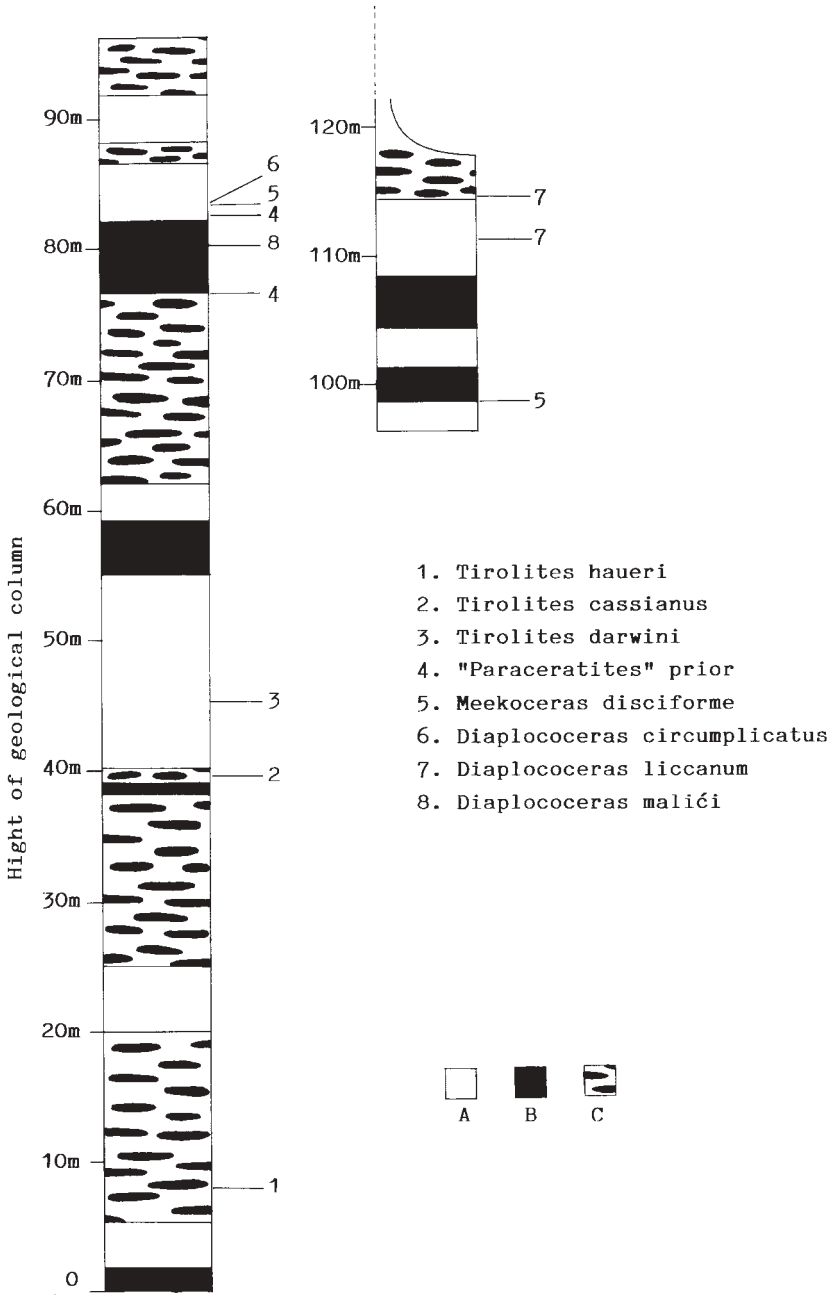

Fig. 5. The distribution of the ammonites in the lower part of the Upper Scythian layers on the Bukovik Hill – South-Western slope (Sutina village near Muć)

BIOSTRATIGRAPHY

In the linear biostratigraphic system of the reference section, with ten horizons defined by the changes in ammonite fauna, species of the genus *Diaplococeras* are distributed according to the following pattern (GOLUBIĆ 1996:173):

D. circumplicatus occurs in the upper part of the third horizon, and in a few layers above.

D. malići occurs in the upper part of the third horizon, and up to the fourth horizon, i.e. it has a slightly wider range than *D. circumplicatus*.

All *D. liccanum* variants, and *D. jazinkae* and *D. tridentatus* occur in the fourth horizon. The vertical distribution of *Diaplococeras* species is shown on two biostratigraphical schemes: Fig. 4 – lower part of the Upper Scythian layers on the standard section (Muć Gornji, Zmijovac) and Fig. 5 – lower part of layers on the south-western part of the Bukovik Hill (Sutina near Muć). The distribution of ammonite species is shown, ranging from the bottom layers to the uppermost layers in which *Diaplococeras* species appear. The investigation of this whole locality showed that the appearance of *Diaplococeras* species is defined by the appearance of the ammonite *Meekoceras disciforme* KRAFFT 1909: 45–47. Until now, it was not known that *M. disciforme* appeared in the lower Triassic of the Dinaric region (Plate I – 4, Plate III – 1; Fig. 3.D, E). There is a wide horizon without ammonites over the upper level with *D. liccanum*, and then *Dinarites dalmatinus* appears.

***Remark:** I labelled biostratigraphical schemes with *Diaplococeras* species and other species as well, to ensure a complete look into the biostratigraphical relations. They are *Tirolites haueri* (MOJSISOVICS), *T. cassianus* (QUENSTEDT), *T. darwini* MOJSISOVICS, *Pseudodinarites mohamedanus* (MOJSISOVICS), *Paraceratites prior* KITTL and thee above mentioned *M. disciforme*. I used old names for three of them (*Tirolites haueri*, *T. darwini* and *Paraceratites prior*) to avoid confusion. Today they are considered to be *Tirolites cassianus* variants, a view I would not necessarily agree with.

DISCUSSION OF THE RESULTS

The topics of this discussion are the following: a) the question of the family to which the genus *Diaplococeras* belongs, b) the criterion for placing the species in the genus *Diaplococeras* and c) the validity of the species represented by *D. liccanum*.

a) SHEVYREV (1968: 163–164) places the genus *Diaplococeras* in the family Dinaritidae, albeit conditionally, and KUMMEL (1969: 503) in the family Tirolitidae. By comparing *Diaplococeras* with the species *Tirolites* and *Dinarites*, I came to the conclusion that the genus *Diaplococeras* should be assigned to the family Tirolitidae.

b) The fundamental criterion for placing the species in the genus *Diaplococeras* is the morphology of *D. liccanum* – morphological traits that are common, with

some exceptions, to the species of that genus. There are three morphological traits: weak or very weak radial ribs with internal and external marginal knots, high and steeply inclined umbilical wall and long, pointed ventral lobes. However, there are variants with reduced sculpture on younger coils, and in *D. circumplicatus* even with completely reduced sculpture, i. e. with a smooth outer surface. So the criterion can be completed as follows: the coil is widest in the interior of the umbilicum, between those points of the lateral walls which are situated near the rim of the umbilical wall. The exception is *D. circumplicatus* with the coil at its widest between the middle lateral points of the walls of the coil, because the wall of the coil is slightly and uniformly rounded. In *Diaplococeras* species, older coils have a very slightly rounded ventral side, i. e. an almost a wide, flat ventral rim. That applies for *D. circumplicatus* too. So, those three traits are sufficient, with an additional remark that the criterion should sometimes be completed.

c) *D. liccanum* and *D. jazinkae* are very closely related species. Differential traits can be seen by comparing the diagram of the suture. It can be objected that the differences are due to diagenetical damage, but the material was controlled very carefully. The different size of the teeth is surely authentic, because traces of strong teeth are common to *D. liccanum* and the damaged species. I chose one damaged specimen with clear traces of teeth to show the suture diagram of *D. liccanum* (Fig. 1.A). All four specimens of *D. jazinkae* are much better preserved, and it was impossible to find a trace of teeth, although the lateral side was only slightly damaged. Four well preserved specimens of *D. liccanum* come from different levels of the fourth horizon and have the identical suture. I can also mention one specimen with a preserved suture from the Franciscan collection in Sinj and one from the Croatian Natural History Museum. There are six preserved specimens of the typical form of *D. liccanum* in Croatia altogether. Including the three new variants, this is not enough for a statistical approach to the population. With some rare variants it was impossible to be certain if they were variants or might be a species. I have offered a typological hypothesis that can be criticised. During my field work I have come to the conclusion that there is no locality in Dalmatia that is rich in *Diaplococeras* species, which makes it impossible to apply a population concept in this research.

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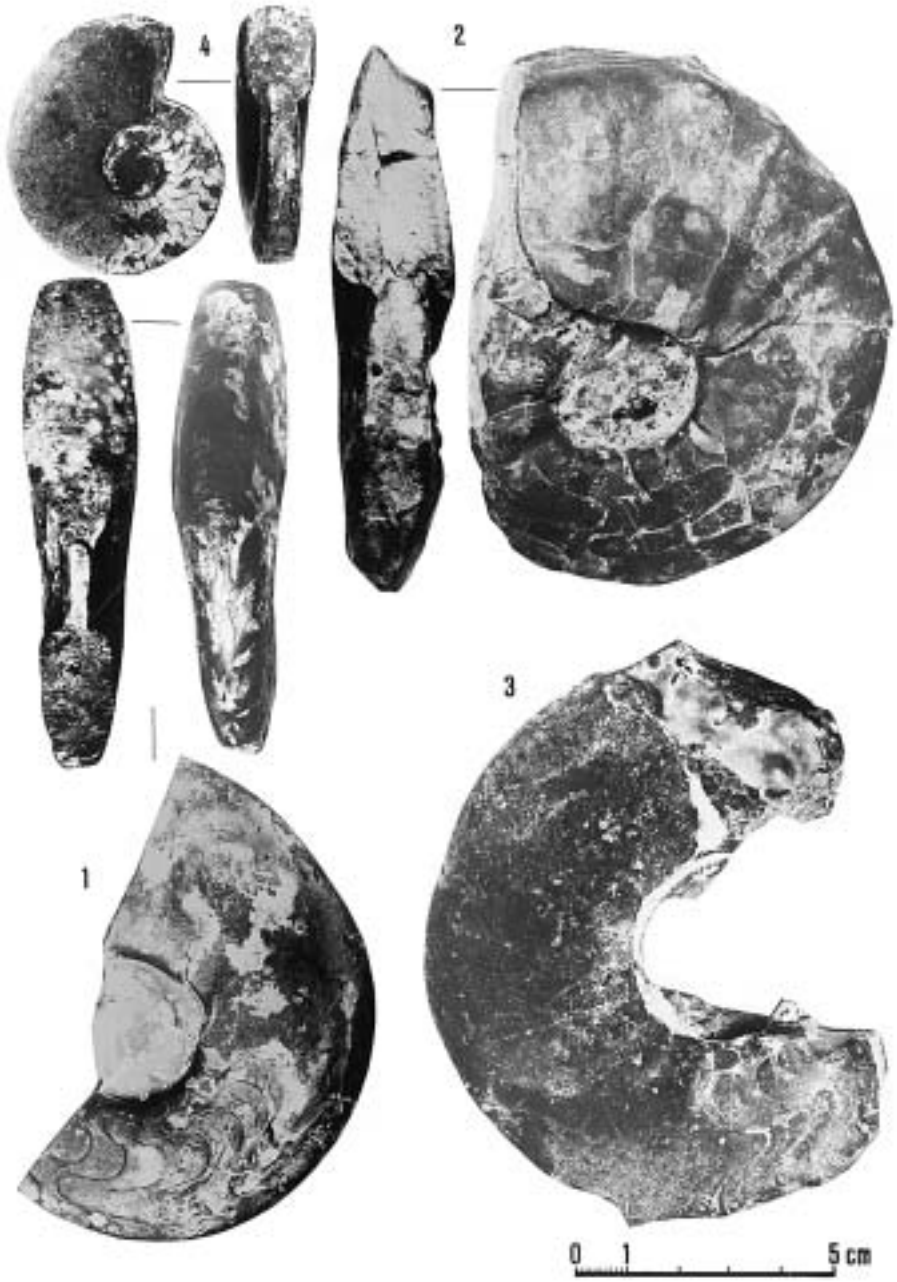

Plate I – 1. *Diaplococeras liccanum* var. *otarnicianus*; 2., 3. *D. jazinkae*; 4. *Meekoceras disciforme*

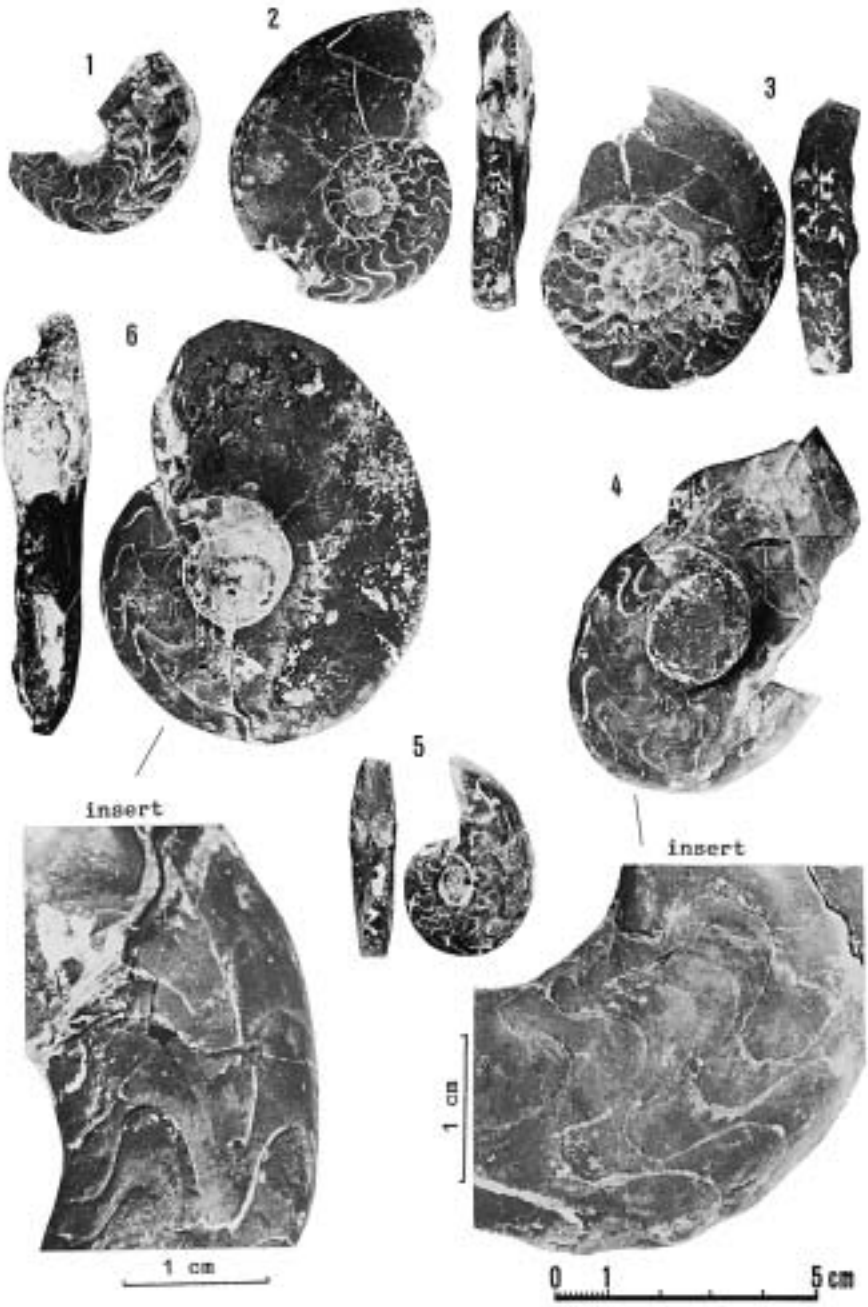

Plate II – 1., 2., 3., 4., 5. *Diaplococeras circumplicatus*; 6. *D. tridentatus*

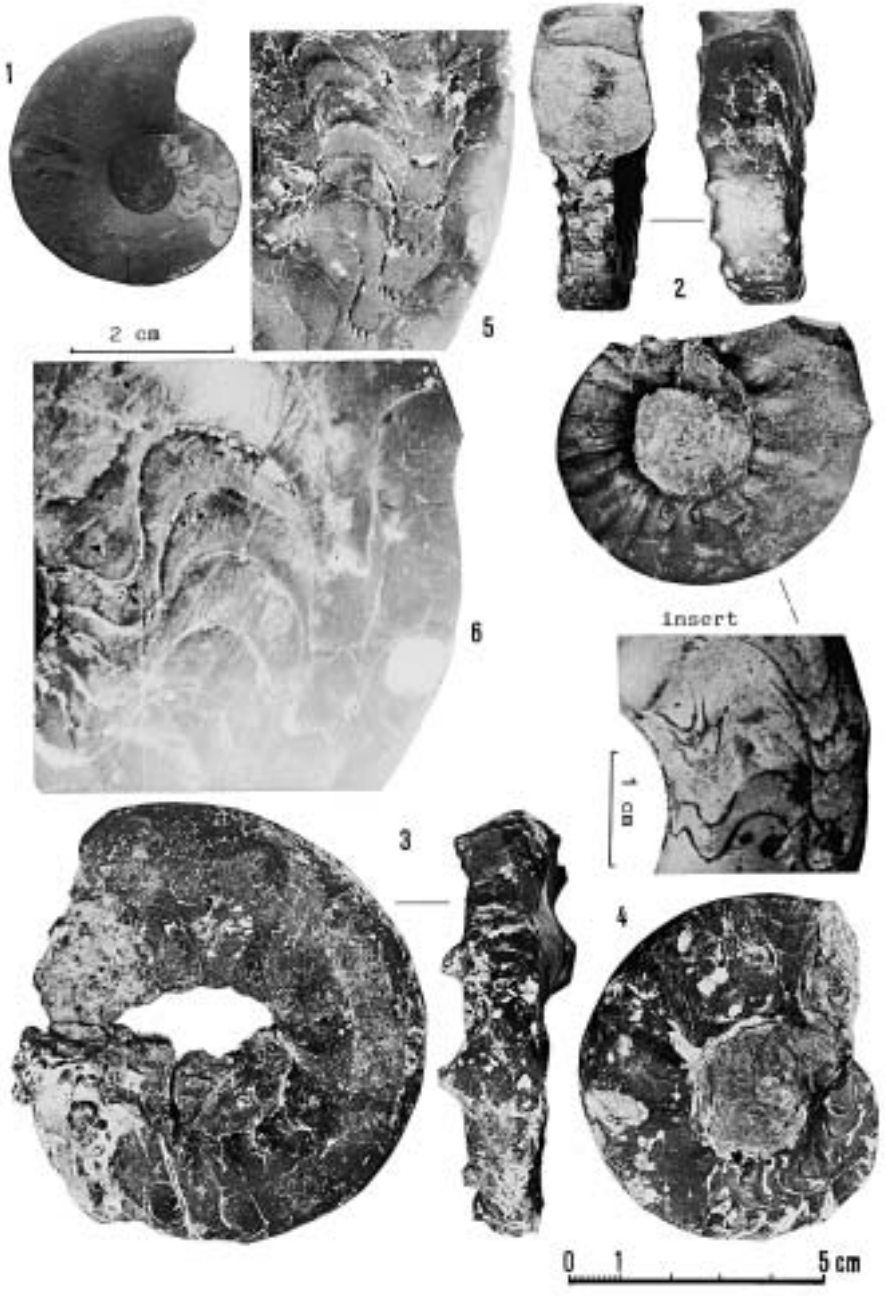

Plate III – 1. *Meekoceras disciforme*, 2., 3., 4. *Diaplococeras malici*; 5. *D. liccanum* (typical form); 6. *D. liccanum* var. *bidentatus*